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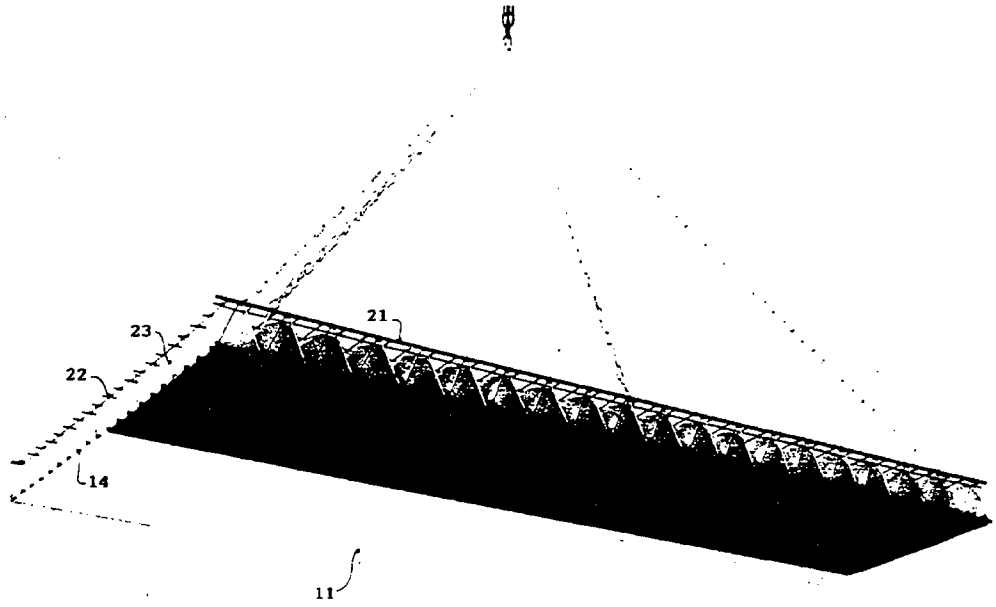
(54) Title: TWO-WAY SELF-SUPPORTING REINFORCEMENT FORMWORK



(57) Abstract

Universal element for in situ flat two-way reinforced deck structures. Effect: optimized industrialization of in situ concrete building. The product is a prefabricated self-supporting lattice element providing all necessary components for any concrete deck structure besides concrete, such as formwork, ceiling surface, reinforcement in two ways and air cavities. The components form part of unit with a fixed precise geometry and accurate amount of material according to predetermined requirements. The element can be industrailly manufactured in a fully automated process. The erection on site is very simple. The elements can be joined directly and are immediately ready for concreting. The industrialization of the in situ work offers large savings in both time and materials, such as the entire horizontal formwork bottom, a large part of the vertical formwork and all the traditional reinforcement binding. Analyses have shown savings up to 30 %.

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Title :

TWO-WAY SELF-SUPPORTING REINFORCEMENT FORMWORK

Technical Field.

The invention relates to two-way concrete reinforcement, i.e. industrially manufactured, prefabricated welded meshes of crossing reinforcement bars.

The invention forms part of an complete invention relating to two-way flat concrete slabs. The first part thereof is described in Danish patent No. 166.462.

Background art.

All options considered, in situ concreted continuous deck is probably the best deck construction available. Unfortunately, this construction suffers under an expensive and time-consuming temperary formwork, and an industrialisation has only been partly achieved in *one-way deck structures*, never in *two-way floor structures.* A method of reducing the formwork in one-way floor structures is to use built-in/permanent formwork. It is generally known to use thin steel panels as permanent formwork and as reinforcement.

The methods are divided into two main categories :

1. The steel panels or sections are used only as formwork - not as reinforcement. This category is thus uninteresting in this connection.

2. The steel panels are used as formwork and reinforcement. This application is especially widely used in the USA and in Sweden. However, the known methods only render it possible to provide *one-way reinforced structures*.
   It is not possible to provide a fixed crossing reinforcement, as the crossing reinforcement bars cannot be connected to the panels by binding and cannot be welded manually to the panels on site, as the thin panels would be burnt through. Furthermore, such a number of weldings would be completely irrational.

Within the first category is the German patent application No. DE 21 10 913. It should be noted that the method cannot even be used for the one-way reinforced structure, as no bearing capacity can be ascribed to the completely free steel surface for fireproofing reasons.

DE 26 04 998, DE 12 45 565, US 3,238,681, FR 1.249.543 and FR 1.152.818 all fall within the second categori. All of the said puplications relate to purely *one-way structures*.

Moreover, DE 25 17 485 is to be mentioned. This publication is however without any relation to the present invention, as it discloses a deck structure of bearing steel beams embedded in concrete and not a reinforced concrete deck structure.

As a result of the missing technic to industrializing two-way constructions, the statically less appropiate *one-way deck structure* is used to a large extend, even in situation in which a *two-way deck structure* would be much more relevant. It is necessary to realize, that a realistic two-way solution can only be provided in connection with industrial welded completed building elements.

Disclosure of the Invention.

The present invention provides a ***two-way reinforcement-formwork,*** a complete steel element construction acting as a two-way reinforcement and as a formwork as well as a complete ceiling all together without the amount of steel being increased. The invention does not merely improve a single process, but provides a machine-processed finished element and thus eliminates a number of processes which conventionally has been carried out manually. The element may be produced completely per automization by slightly altering the known machines for welding conventional reinforcement meshes, and the elements can be supplied prefabricated in sizes up to 40-50 m^2 Moreover, by means of the automatic production a substantially more accurate, stable and high-quality product is obtained which eliminates uncontrollable processes and loss of time.

This is particularly important for two-way reinforced in situ concreted structures, as the horizontal formwork (form bottom) which traditionally constitutes 2/3 of the formwork costs may be eliminated. Furthermore, to a large extent the element is self-supporting in the longitudinal direction of the bottom panels, whereby the vertical formwork support may be considerably reduced.

And very important the stable and accurate elements are so simple to place, that the work on site may be carried out by reduced and unprofessionel manpower. Analyses have shown savings in the form- and reinforcement-work of the amount about 20-30%.

The self-supporting two-way reinforced formwork according to the invention is characterised in that a conventionally welded two-way reinforcement mesh is altered in such a manner that the lower layer of reinforcement bars is tranformed into sheet panels having the same steel cross- section area as said lower bars and being interspaced corresponding to said bars of the conventional mesh, whereby a two-way reinforcement is obtained having on one side open meshes formed of the upper layer of bars and ribs in the sheet profile and thus free passage for concrete and having on the other side an underlying continuous steel surface which in addition to the normal reinforcement function acts as formwork and ceiling.

The geometry of the sheet profile is adapted in such a manner that in case of fire the exposed bottom part may be disregarded, as the completely embedded ribs are sufficient to ensure the bearing capacity according to the standard fire-proofing requirements. The height of the ribs in the sheet profile may be varied in relation to the the desired bearing capacity, the fire resistance, interspacing of the intermediate supports, etc. as the bearing capacity also may be increased by filigree beams at the edge.

In a particular embodiment (claim 2) of the invention suitable for for hollow floors, a two-way spatial reinforcement formwork is formed (named Compo-Deck), by incorporating a lattice with hollow bodies (the inventor's own patent DK 166.462). As a result, a universal element is formed comprising a self-supporting complete lattice of steel and hollow plastics bodies and having all the needed and desired deck structure elements besides concrete, viz. formwork, reinfocement, air cavities and ceiling surface, all united in a geometrically fixed unit, which can be industrially manufactured in fully automated manner.

In a third embodiment (claim 3) of the invention suitable for solid floor structures a two-way reinforcement formwork is formed by means of filigree beams and upper mesh and without hollow bodies.

Brief Description of the Drawings

The invention is described in greater detail in the following with reference to the accompanying drawings, in which the most developed structure (Compo Deck) is used as illustration and in which

Fig. 1 shows a principle part of a reinforcement-formwork according to the invention.

Fig. 2-7 show an example of the incorporation of the reinforcement-formwork in a completed deck structure (hollow floor).

Fig. 2 is a cross-sectional view of two joined reinforcement-formwork elements.

Fig. 3 is a cross-sectional view of an element at the edge.

Fig. 4 is a longitudinal sectional view of two joined elements.

Fig. 5 is a longitudinal sectional view of an element at the edge.

Fig. 6 is a top view of two joined elements.

Fig. 7 is a top view of an element with edge formwork.

Fig. 8 is a photo of an element in a top view.

Fig. 9 is a photo of an element seen from below, one half of the lower face being painted white

Detailed Description of the invention.

The two-way reinforcement-formwork of fig. 1 is constructed quite analogous to usual welded reinforcement meshes and by means of the same welding machinery, said machinery being adapted to receive plate profiles instead of reinforcement bars.
The completed reinforcement-formwork (10) comprises a thin-walled bottom formed by a profiled thin-walled sheet or abutting sheet panels (11) arranged in parallel and welded together at the top with a number of transverse conventional reinforcement bars (12).
The plate profiles are formed with ribs (14) spaced corresponding to the spacing of the crossing bars (12). The panels may be the simple C-profile as shown on the figure, other embodiments are, however, possible and suitable.

It is thus possible to shape the profiles to be lined with outer fireproofing or inner fixing material, into which screws can be fastened.

Figs. 2 to 7 illustrate the reinforcement-formwork forming part of a concreted hollow floor (Compo-Deck). The hollow bodies (23) rest directly on the reinforcement-formwork (10) forming the lower mesh of the lattice with hollow bodies. In the embodiment shown, two reinforcement elements are joined and the form bottom closed by means of a separate section (18) identical to the sheet section (11). On each side, the reinforcement elements are supported by a filigree beam (21) welded to the lower mesh (12) and the upper mesh (22) in order to improve the strength during transport and during casting of the concrete. The formwork may be completed and sealed, also in a prefabricated embodiment, by means of side walls being arranged at and welded to the outer periphery of the outer reinforcement elements, e.g. side section (16) and end section (17) essentially corresponding to the sections (11).

Claims

1. A two-way industrially welded prefabricated reinforcement mesh, c h a r a c t e r i s e d in that a conventionally two-way welded reinforcement mesh is altered in such a manner that the lower layer of reinforcement bars is tranformed into sheet panels having the same steel cross-section area as said lower bars and being interspaced corresponding to said bars of the conventional mesh, whereby a *two-way self-supporting reinforcement-formwork* is obtained having on one side open meshes formed of the upper layer of bars and ribs in the sheet profile and thus free passage for concrete and having on the other side an underlying continuous rigid steel surface which in addition to the normal reinforcement function acts as formwork and ceiling.

2. A two-way spatial self-supporting reinforcement-formwork according to claim 1, c h a r a c t e r i s e d in that a hollow body lattice is incorporated therin. (Hollow deck).

3. A two-way self-supporting reinforcement-formwork according to claim 1-2, c h a r a c t e r i s e d in that the embodiment is the same as in claim 2, but without the hollow bodies. (Solid deck).

4. A two-way self-supporting reinforcement-formwork according to claim 1-3, c h a r a c t e r i s e d in that the formwork bottom on the lower face or upper face is coated with a material for vaious purposes, such as fire-proofing, sound-proofing and fixing, etc.

5. A flat concrete deck provided with a reinforcement-formwork according to one or more of the claims 1-4.

AMENDED CLAIMS

[received by the International Bureau on 14 November 1994 (14.11.94);
original claim 5 cancelled; original claims 3 and 4 amended;
remaining claims unchanged (1 page)]

1. A two-way industrially welded prefabricated reinforcement mesh, c h a r a c t e r i s e d in that a conventionally two-way welded reinforcement mesh is altered in such a manner that the lower layer of reinforcement bars is tranformed into sheet panels having the same steel cross-section area as said lower bars and being interspaced corresponding to said bars of the conventional mesh, whereby a *two-way self-supporting reinforcement-formwork* is obtained having on one side open meshes formed of the upper layer of bars and ribs in the sheet profile and thus free passage for concrete and having on the other side an underlying continuous rigid steel surface which in addition to the normal reinforcement function acts as formwork and ceiling.

2. A two-way spatial self-supporting reinforcement-formwork according to claim 1, c h a r a c t e r i s e d in that a hollow body lattice is incorporated therin. (Hollow deck).

3. A two-way self-supporting reinforcement-formwork according to claim 1-2, c h a r a c t e r i s e d in that the bottom profile is shaped as a concrete plate with partly embedded steel profiles/bars as ribs .

4. A flat concrete deck provided with a reinforcement-formwork according to one or more of the claims 1-3.

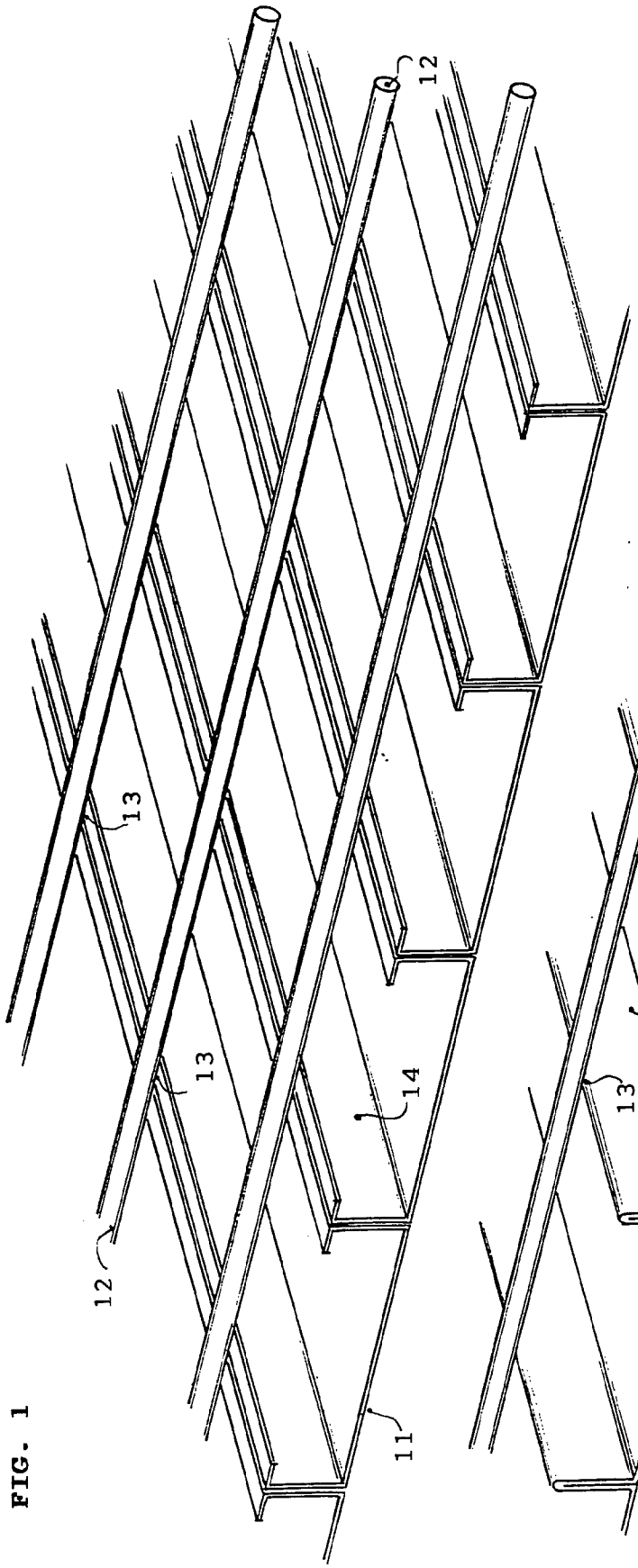

FIG. 1

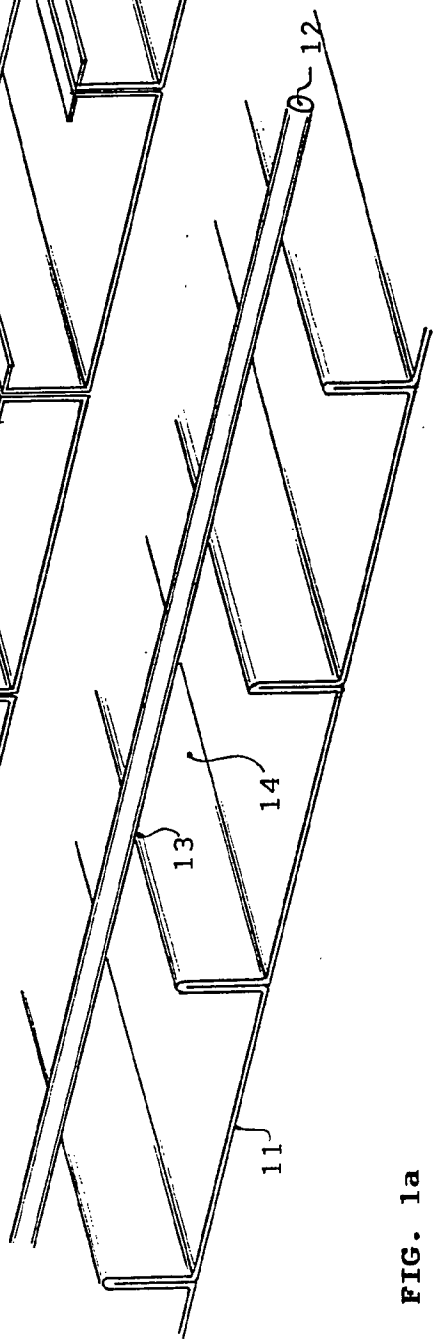

FIG. 1a

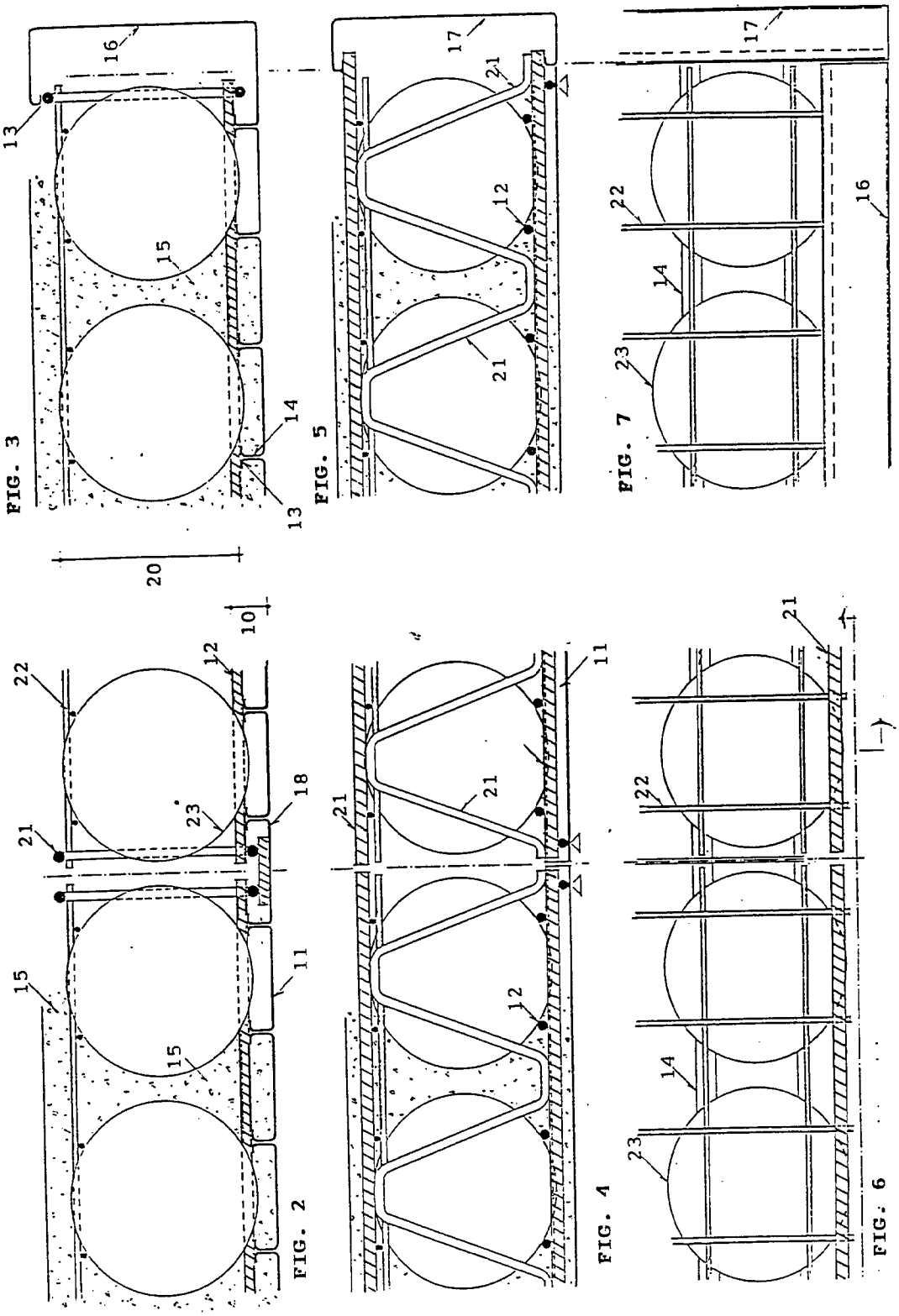
FIG. 3
FIG. 5
FIG. 7
FIG. 2
FIG. 4
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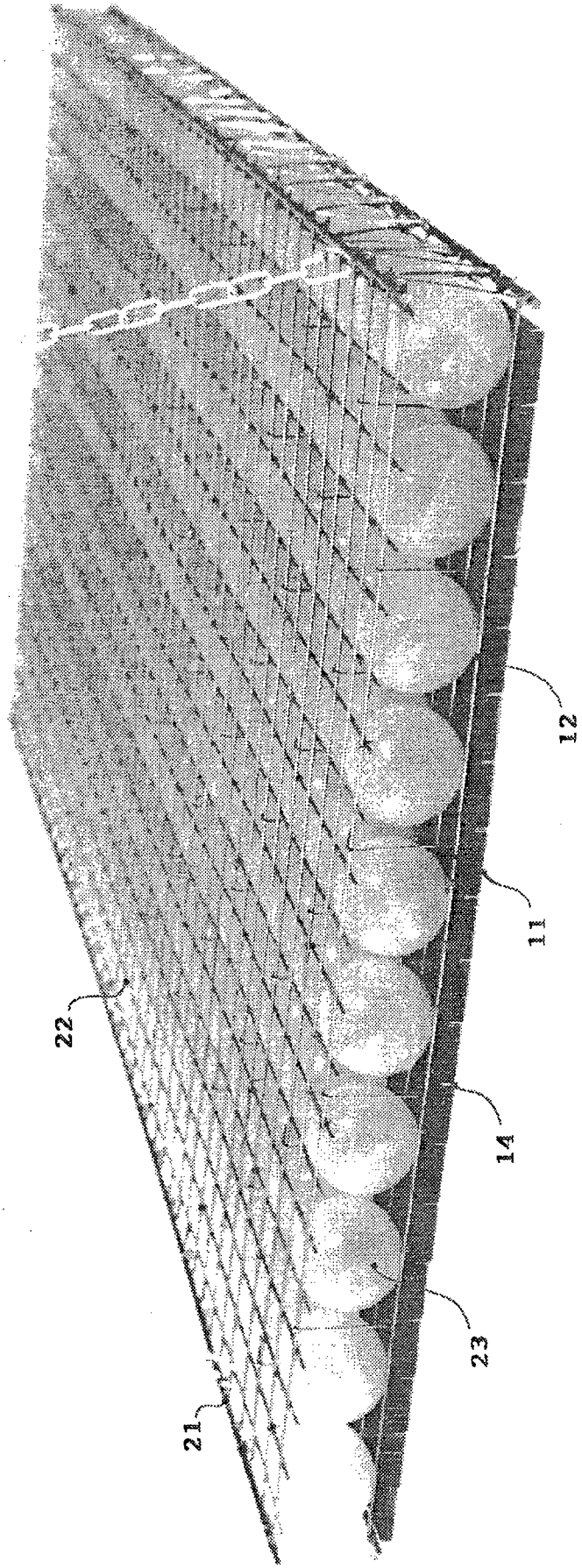

FIG. 8

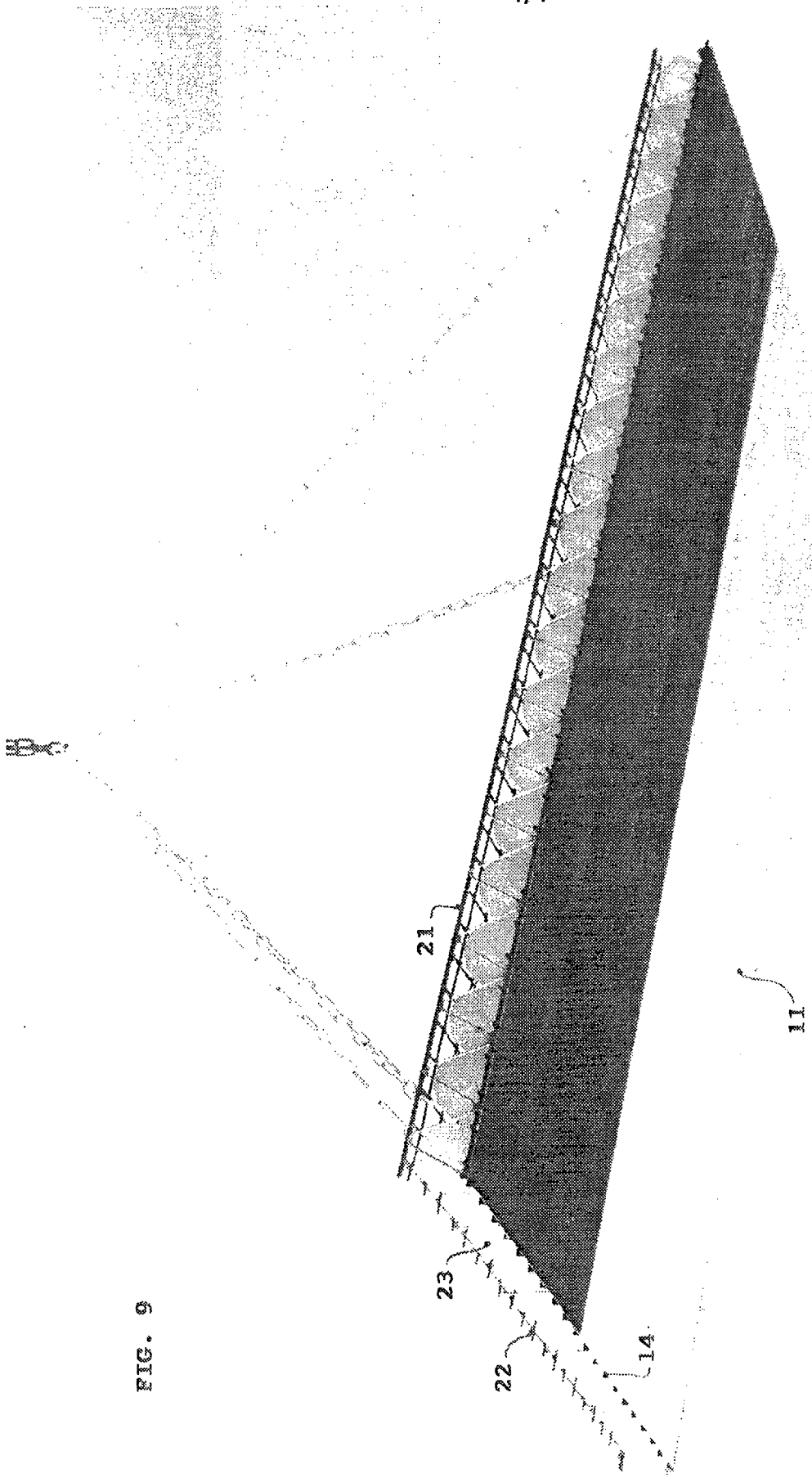

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 94/00231

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: E04B 5/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 1073540 (P.M. STEWART), 16 Sept 1913 (16.09.13), column 2, line 22 - line 28, figure 2, details 10,20,28	1
Y	--	2,3,4
X	US, A, 2912848 (R.E. LEE ET AL), 17 November 1959 (17.11.59), column 2, line 72; column 3, line 1 - line 2; column 3, line 51 - line 58, figure 1	1
Y	--	2,3,4
Y	WO, A1, 9206253 (BREUNING, J.I.), 16 April 1992 (16.04.92), detail3	2
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3930348 (H.H. WISE), 6 January 1976 (06.01.76), details 22,44,40	3
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Y	DE, C, 516914 (J. HEATON ET AL), 29 January 1931 (29.01.31), column 2, line 55 - line 56, detail d	4
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A	DE, A, 2110913 (REIMBERT, A.), 18 November 1971 (18.11.71), figure 2, detail 9	
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INTERNATIONAL SEARCH REPORT

Information on patent family members

27/08/94

International application No.
PCT/DK 94/00231

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 1073540	16/09/13	NONE	
US-A- 2912848	17/11/59	NONE	
WO-A1- 9206253	16/04/92	AU-A- 8631291	28/04/92
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		EP-A- 0552201	28/07/93
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		FR-A- 2081159	03/12/71
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